



## Nourishing Reliability Through Healthy Assets

*By Rick Baldrige, CMRP; Tim Goshert, CMRP; John Schultz, CMRP*

For about the last fifteen to twenty years, the maintenance and reliability industry has been talking about Asset Health. Software companies have helped enable this thinking by making simple Red – Yellow – Green score carding simple. What do the colors mean? Well, the easiest way to explain it might be with an analogy...

### **Analogy To Personal Health**

Analogies are always being drawn between a facility's asset health and a person's health. If you have been in the maintenance business for any length of time, you have certainly heard this correlation. To help illustrate the connection, the following is a true story as told by one of the authors - Rick Baldrige...

My last name is Baldrige. Every single male as far back as we could go on the Baldrige family tree, with the exception of my father, my brother and me, has died of massive heart attacks. On my mother's side of the family, every single person, male and female, including my mother has fought a long, arduous battle with cancer. What does that say about my future? Let's just say it doesn't look too bright. In fact, I better finish my input to this article pretty quickly.

When my father turned 42 he really began thinking about this. His brother, father, all of his uncles, grandfather, as far as he could go back had passed away due to massive heart attacks. He gathered up all of the family history he could find and took it to his doctor. The doctor reviewed his history and said

to my dad, 'This does not look good for you'. The doctor scheduled several exams, one of them being a blood chemistry analysis. One of several specific tests was for cholesterol. Cholesterol is like dirt and is the biggest enemy to the heart. The overall alarm band should not exceed 200, and most doctors have adjusted the alarm band to 180. My father's cholesterol was over 700. The doctor believed my dad was a walking heart attack and wanted to put him into an ambulance and immediately check him in to the hospital.

Of course, I had very similar concerns when I turned about 38. I went to the doctor and discovered that my cholesterol was 441. So why were all of the Baldrigedies dying of heart attacks? Without a quantitative assessment of my personal health would I have known that I had a circulatory problem?

This is the likely scenario. I enjoy and do a lot of hunting and fishing. I would have been walking across the prairie, up a hill or through the woods. I would become winded and have to stop to rest. Soon, my upper arms and shoulders would begin to ache. I would then feel like my 1996 Chevrolet 4-wheel drive pickup was parked on the middle of my chest. What happens next? Someone would be throwing dirt on top of me.

Do you happen to know what the first symptom is for 60% of all heart attack victims? I sure do. It turns out that the first symptom for those 60% of victims is death. What does that P-F curve look like? The

subsequent collateral damage associated with point F is an unacceptable consequence of failure.

My father turned 72 on October 28 and in November we went deer hunting together in North Dakota. Chemically treated, his cholesterol is 117. My non-chemically treated cholesterol level is 177. In addition, we have researched all of the predominant male associated cancer failure modes on my mother's side of the family. Through research and quantitative assessment, I now know my current overall level of health and the failure modes that pose the biggest risk to me in the future. My mantra is "Early detection and elimination of defects".

Oddly enough, that sounds like a pretty good mantra for a proactive maintenance program as well.

### What's the Difference?

What is the difference between understanding defects within our industrial physical assets and our personal body systems? Basically, the only difference is the consequence of failure. If we want to eliminate as many failure modes as possible, we

need to gain an understanding of the health of our facilities. Running a battery of tests to determine if an asset is healthy is an easy correlation to draw.

Unfortunately for the machinery condition monitoring community, few organizations have focused sufficient engineering forethought into putting all of the foundational elements necessary for meaningful asset health into place.

How difficult can it be to go do a bunch of condition monitoring (CM) and assign RED – YELLOW – GREEN. It's really not very difficult... unless, of course, you want it to mean something. Let's say we want to compare the percentage of healthy (GREEN) assets in a corn milling operation in the Netherlands to the percentage of healthy assets in a Corn Milling operation in Iowa. To make that comparison, we need for key foundational elements and standards to be in place. If standards aren't in place within an organization, there will most likely be a long debate on the definitions of RED – YELLOW – GREEN. In the medical health monitoring community, there is a clear and consistent understanding of what the possible failure modes

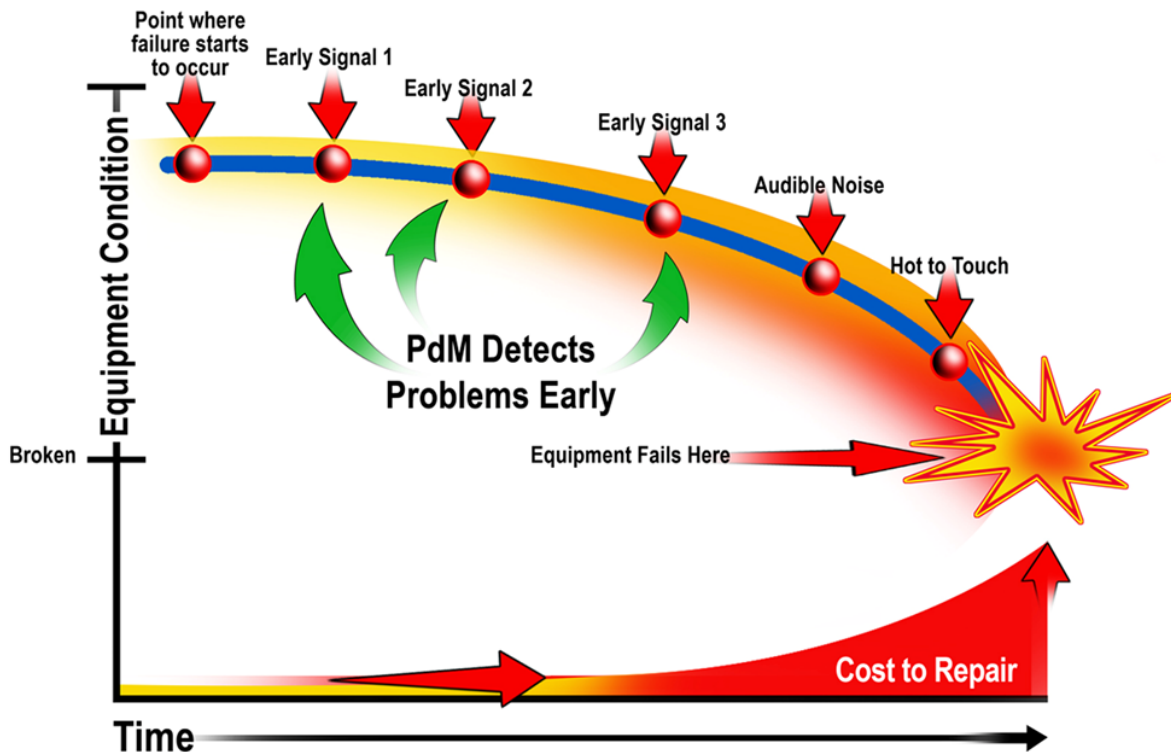


Figure 1 - P-F Curve

are, what battery of tests should be run to detect those failure modes, and what “healthy” looks like for each test.

For asset health to be taken seriously by senior leadership, it must be standardized, meaningful, and repeatable. An asset health standard must be created. This year Cargill had their fifth internal Worldwide Maintenance & Reliability Conference. This conference had over 300 attendees and Cargill announced that next fiscal Year, they would begin to report asset health as a key balanced scorecard metric to their leadership team. This is a big step forward by a major worldwide organization and its implications should not be underestimated.

### Nourishing Reliability Through Healthy Assets

Cargill is one of the world’s largest privately held corporations. Cargill also holds other distinctions such as a having a passionate vision statement of “Nourishing the World” and having more Certified Maintenance and Reliability Professionals (CMRP) than any other corporation in the world. Cargill believes that their approach to maintenance and reliability is a competitive advantage and, to most organizations’ surprise, it is not all about “maintenance costs”.

As Ron Christenson, Cargill’s Chief Technology Officer, points out:

“A key element of Cargill’s strategic intent is be the “partner of choice” to worlds we serve. Underlying being a partner of choice is trust. Cargill’s COO, Greg Page, defines trust as promises made and promises kept over time. The most fundamental promise we make to our partners is to deliver our products and services on time, every time. That can only be achieved with world class plant reliability. Cargill has been on the journey to world class reliability for more than 10 years and our partners are benefiting from our improved reliability. Reliability is an

important factor in Cargill being chosen by our customers.”

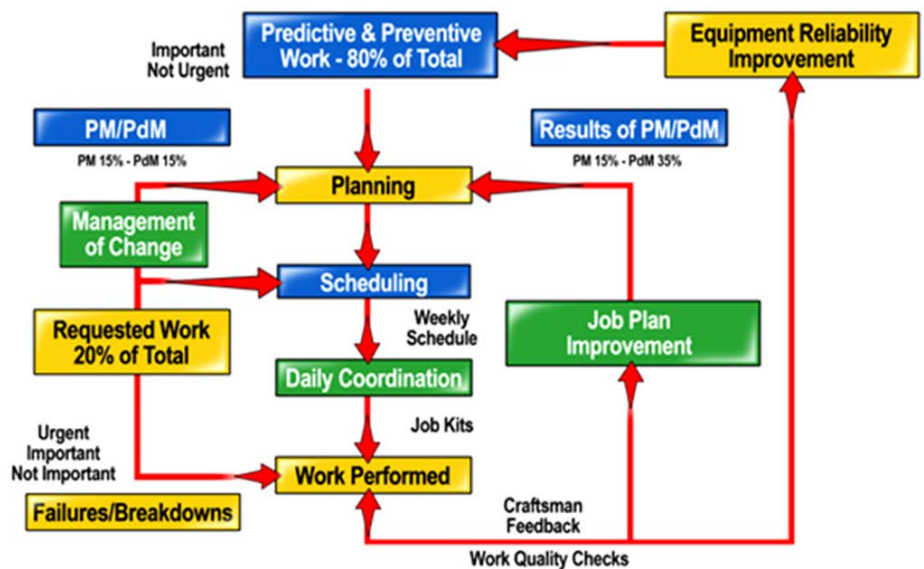
Like many other corporations, Cargill adopted the concept of creating corporate Centers of Excellence (COE). One of the COEs is set up for Maintenance and Reliability, and its mission is to:

“Define and establish direction and leadership to the corporation’s business units to promote and champion the implementation of maintenance & reliability concepts for increased reliability, lower costs and improved asset health of facilities worldwide.”

It’s important to notice that maintenance costs is an outcome of focusing on increasing asset reliability. At the base of improving asset reliability is Cargill’s initiative to measure, manage, and improve the health of the assets.

With regard to the often utilized P-F Curve (Figure 1), most “maintenance initiatives” focus on Point F and try to “manage the event”. When your focus is on asset health, your focus is on Point P – “early identification and elimination of the defect”. So, as soon as an inspection (though either a PM or condition monitoring) can identify that a defect is present (Point P - “Early Signal”), that asset is RED!

This early identification of the defect can enable the



proactive workflow model (Figure 2). This is in

marked contrast to merely utilizing the technologies to optimize a run to failure maintenance strategy. If you have an optimized PM/condition monitoring process that is failure mode driven, that process (including inspections and follow-up work) drives 75-85% of your workflow. If you plan and schedule your work, execute the work with precision, and have a continuous improvement process – you will be a pace setter – period.

### Asset Health Standard

The steering committee was convinced that asset health needed to be a balanced score card metric, but it was also convinced that for it to be meaningful, a standardized approach had to be applied. As with any important metric in any corporation, if there was no standardization, the metric would approach and exceed expectations regardless of what was really happening. Cargill and Allied Reliability jointly developed an Asset Health Standard (Figure 3) to

address this need.

### The Challenge

There were two concerns expressed by Cargill leadership that had to be addressed – How Much and How Well.

**How Much** - how do we know that a facility reporting Asset Health is applying the standard to a high enough percentage of their assets to be representative? In other words, many facilities only apply condition monitoring technologies to 10% of their most critical assets, or only supply a couple of technologies. This approach will not enable the Proactive Workflow Model, will not drive bottom line results, and will not give you a representative picture of your Asset Health. Figure 4 is an example from a plant where the “Grey” represents how many assets the given technology could be applied to, the “Green” represents “Best Practice Performance”

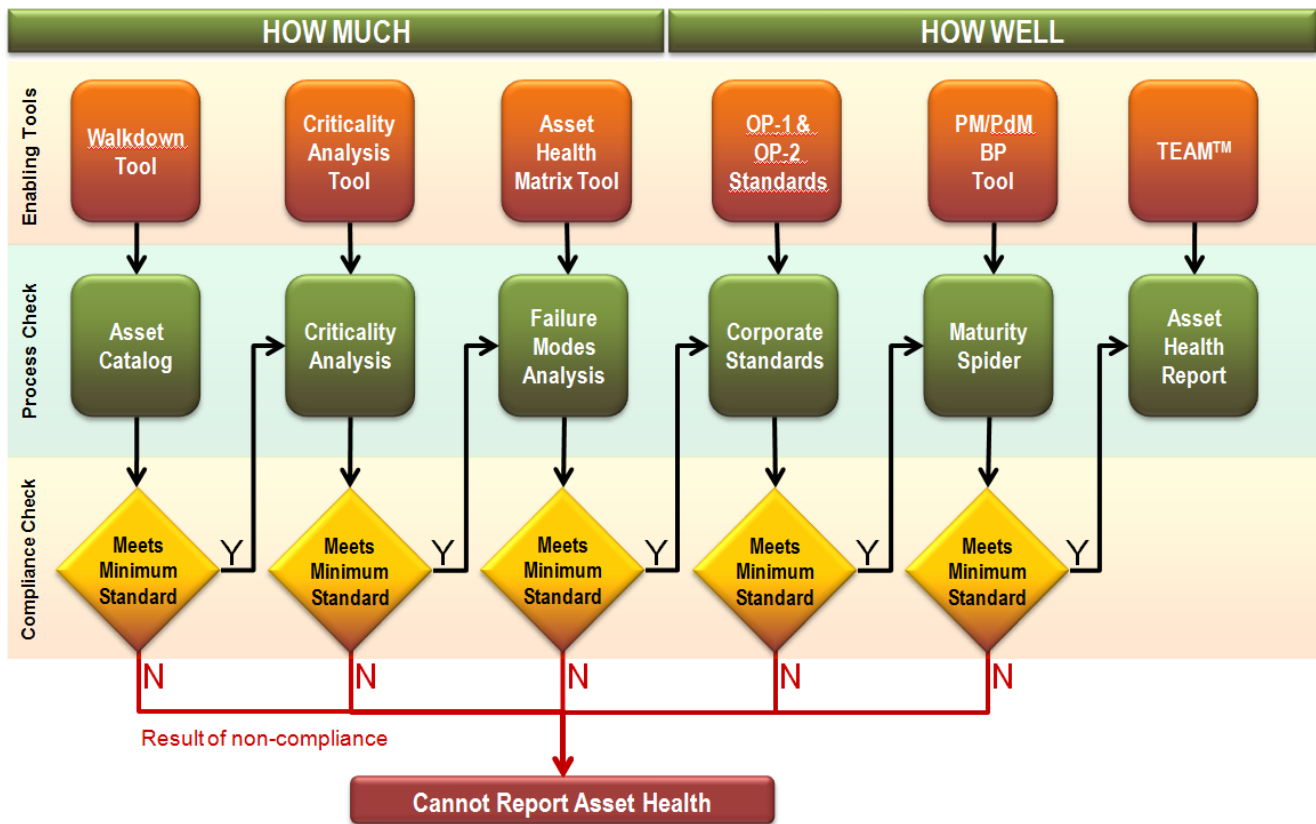


Figure 3 - Asset Health Standard Flow

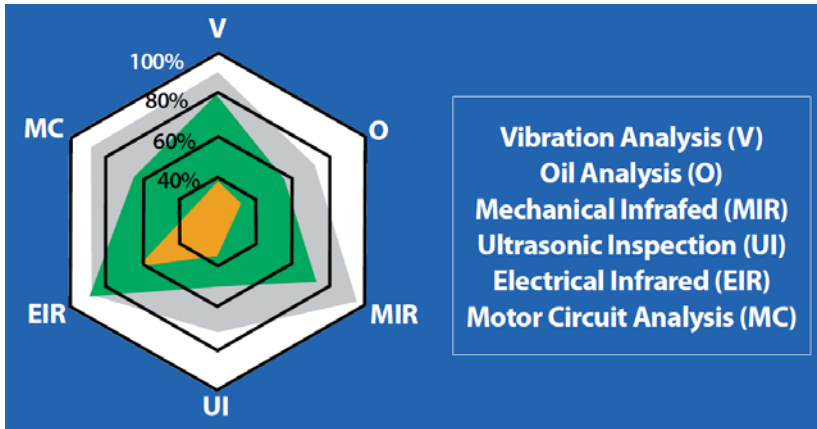


Figure 4 - How Much Condition Monitoring Coverage?

based on benchmarking, and the “Orange” represents a plant’s given level of coverage. An organization must identify what the MINIMUM level of coverage required is before a site has earned the right to report Asset Health.

**How Well** – how do we know that everyone is applying the same standards, in the comparable way, and with a comparable level of rigor? It has been found that many organizations will try to take short cuts and apply less effective Condition Monitoring technologies, lulling themselves into a false sense of security. While many of these techniques (overall vibration pens, point radiometers, etc.) are great “additions” to the Condition Monitoring process to drive additional engagement, they should not be a substitute. Every technology needs to have a written standard for personnel and for technology execution. Compliance to those standards must be periodically audited or it is likely that standards will slip. Figure 5 is an example of a scoring table that is used to assign level of maturity. However, detailed data sheets and qualified assessors must also be utilized to guarantee consistent application of the scoring process. Once each technology has been scored and the supporting work process has been evaluated against the standard, an overall

Maturity score is assigned (Figure 6). The standard must include the minimum standard for “How Well” that is required before a site can report Asset Health.

As shown in Figure 3, we identified that the Asset Health Standard must address both How Much and How Well.

**The Process – The Required Elements**

The process is broken down into three distinct elements that are all required for successful and consistent application of Asset Health – Enabling Tools, Process Steps, and Compliance Checks.

**Enabling Tools** – Cargill has over 1,200 operating locations in over 60 countries and is engaged in over 80 businesses globally. It was determined early on that enabling tools are absolutely necessary to ensure effective and efficient application of Asset Health. These tools enable the process steps and identify the compliance criteria that must be met to go to the next toll gate. For instance a walkdown tool was developed that ensures the correct data for the development of an Accurate Asset Catalogue. If you use and are task qualified on the tool, it is highly likely that you will meet the acceptance criteria. The focus was on the process steps and the tools were developed to enable those steps.

**Process Steps** – There are five prerequisite

Element	Level 1	Level 2	Level 3	Level 4	Level 5
Quartile Coverage	Spot Checks	4th	3rd	2nd	1st
Expectation	Trouble Shoot	Optimize Run to Failure Strategy	Do More PdM	Enable Proactive Workflow Model	Early Elimination of Defects & Root Causes
Employee Certification & Qualification	Nothing Formal	Level I - Supplier	Level II with Written Practice	Level III to International Standards	Certification plus Task Qualification
Standards & Controls	Nothing Formal	Based on Individual motivation skills, multiple people inputting data	Some basic database standards created with controlled input	Standards created with controls to monitor, formal workflows exist	Advanced standards created and MOC process used for changes

Figure 5 - Sample Scoring Table

process steps that must be in place before a site is allowed to report Asset Health:

1. The site must have an Accurate Asset Catalogue
2. The site must have completed a cross-functional Criticality Analysis
3. The site must have utilized an Asset Health Matrix (Figure 7, page 13)
4. The site must have met both the personnel certification and technology application standards established by the COE.
5. The site must be applying all of this to the required Level of Maturity

**Compliance Checks** – For each process step, detailed compliance criteria had to be developed

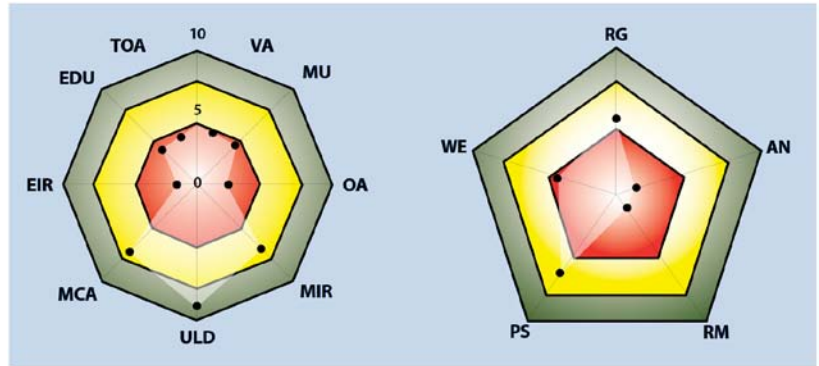


Figure 6 - How Well

and rigorously applied for the Asset Health Metric to have any meaning.

**Process Steps Highlighted**

Asset Catalog – questions such as what level of hierarchy granularity and what equipment data fields

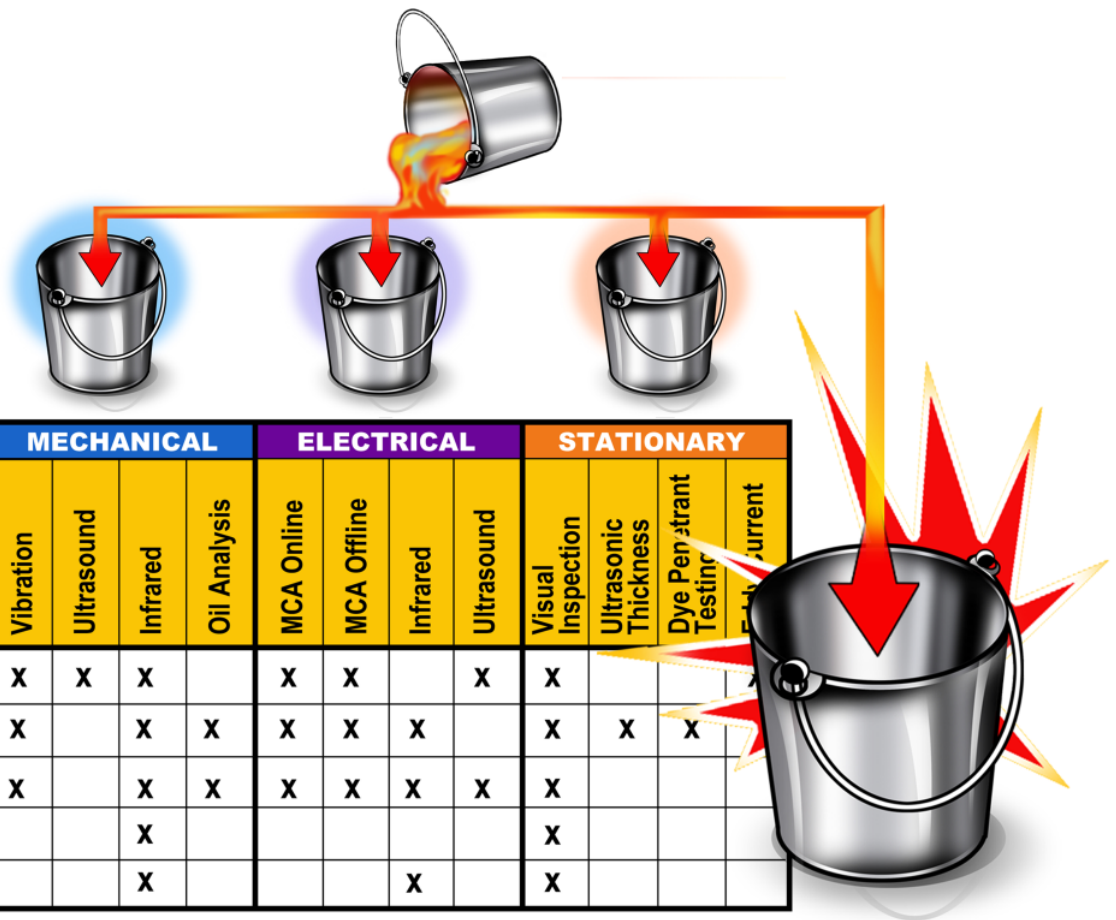


Figure 7 - Asset Health Matrix

must be populated are just a few examples of criteria that must be identified and satisfied.

Criticality – what functional areas must participate and what level of granularity must be incorporated are examples of criteria that must be defined and met for compliance with this process step.

Asset Health Matrix – what percentage of your mechanical, electrical and stationary assets must be on the program and what are the minimum failure modes that must be monitored for inclusion?

Corporate Standards – Do the site personnel meet the certification requirements outlined in the corporate written practice (training, testing, experience, oversight) and are the technology databases/inspection procedures compliant with the corporate standards?

Maturity Level – An annual audit by qualified personnel to ensure that the other elements are in

place and that the supporting work processes meet the minimal level of maturity. Subjectivity must be minimized by providing high quality assessment questions; this will include well defined answers, a definition of question purpose, a definition of what best practice within that question looks like, how to validate data, and the targeted KPIs.

## Conclusion

Like any other metric, for Asset Health to have any meaning, it must be defined. The definition must include “How Much” and “How Well”. If the criteria are not met, a site must not be allowed to report the metric. To date, Asset Health has been a philosophy, but today with standard definitions, it is a Key Performance Indicator that the Cargill leadership team needs to use to drive our reliability improvement.

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*Rick Baldrige, CMRP, has 26 years of experience working in the agriculture and food processing industry. Rick is currently the Reliability Leader for the North American Grain and Oilseeds Export and Processing business units within Cargill, Incorporated. He holds a Bachelor of Science degree in Animal Science and an associate degree in business and psychology from North Dakota State University. Contact Rick at [rckb2@charter.net](mailto:rckb2@charter.net) or [rick\\_baldrige@cargill.com](mailto:rick_baldrige@cargill.com)*

*Timothy Goshert has 28 years of experience working in the food processing industry. Tim's current role is the Worldwide Reliability and Maintenance Manager with Cargill, a position held since 2000. In his current role, he is responsible for the company's worldwide reliability and maintenance initiatives and is chairman of the company's Worldwide Reliability and Maintenance Steering Committee. Tim holds a B.S. in Chemical Engineering from Penn State University. Tim earned his CMRP (Certified Maintenance & Reliability Professional) designation from SMRP in 2001. Contact Tim at [tgoshert@hotmail.com](mailto:tgoshert@hotmail.com) or [Timothy\\_Goshert@cargill.com](mailto:Timothy_Goshert@cargill.com)*

*During the last 16 years, John Schultz has helped over 200 manufacturing locations save millions in direct costs, while increasing production, improving quality and reducing inventories. After helping Eli Lilly & Company develop one of the best reliability programs in North America, John founded Allied Services Group in 1997 – now called Allied Reliability, which is a consulting firm and service provider to some of the biggest names in American manufacturing, such as Cargill, Pfizer and Alcoa. A native of Terre Haute, Indiana, John holds bachelor's degrees in Mechanical Engineering and Economics from Rose-Hulman Institute of Technology. He lives in Charleston, SC with his wife and two children, and can be reached at (812) 841-9252 or [schultzj@alliedreliability.com](mailto:schultzj@alliedreliability.com)*